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(54) Abstract Title
Determining a cost function from the actual resource impact of supporting a subscriber in a communications system

(57) A resource impact is determined which may be an interference increment in the system caused by supporting the communication of the given subscriber unit. Alternatively the resource impact can be dependent on the performance of the subscriber unit when communicating and/or a signal to noise level required for supporting the communication need of the subscriber. A relative resource impact is evaluated from the actual resource impact compared to a nominal resource impact. The nominal resource impact may be the resource impact of supporting a subscriber averaged over all propagation conditions and assuming a subscriber unit having a specified performance. A cost function is calculated from the relative resource impact and is used to modify a resource allocation, call admission or a billing parameter such as the cost of the call to the subscriber.

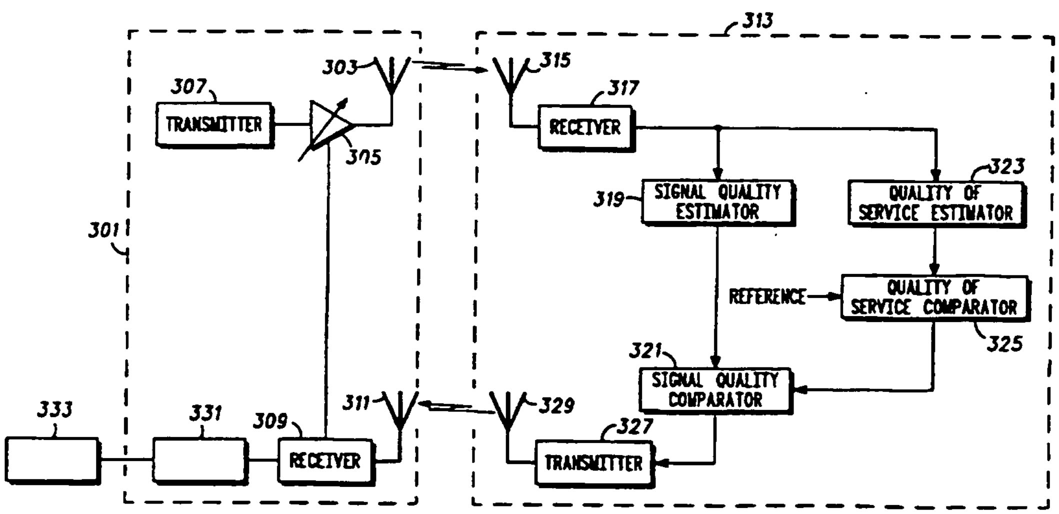

FIG. 3

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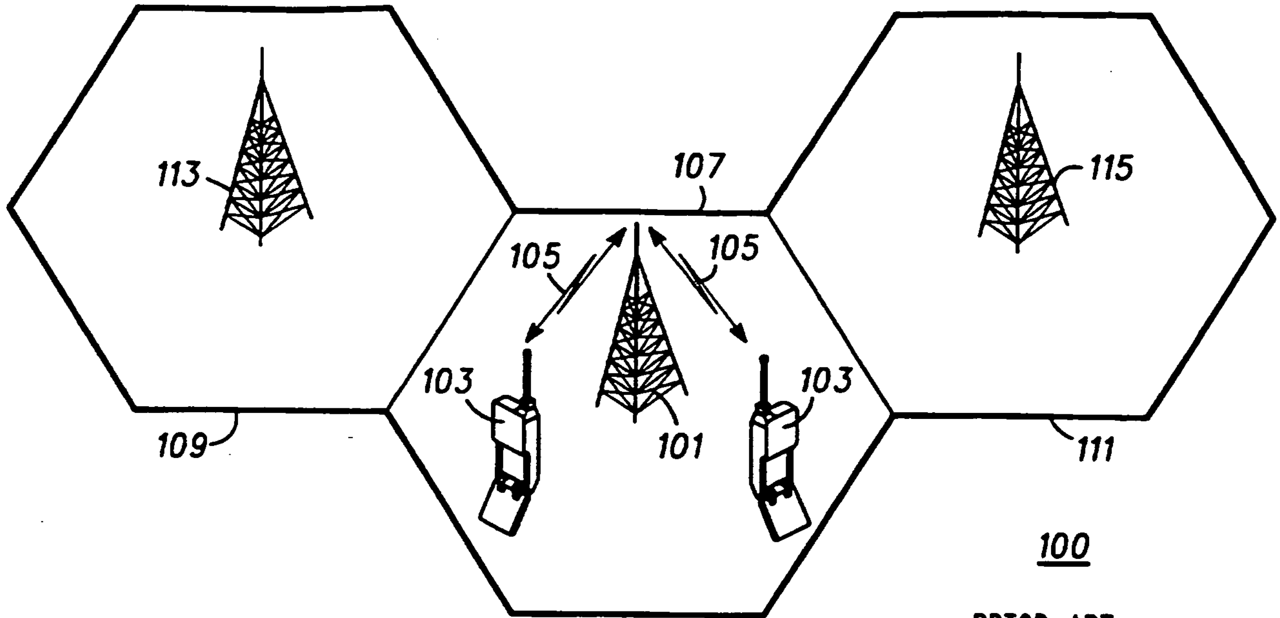
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.



-PRIOR ART-

FIG. 1

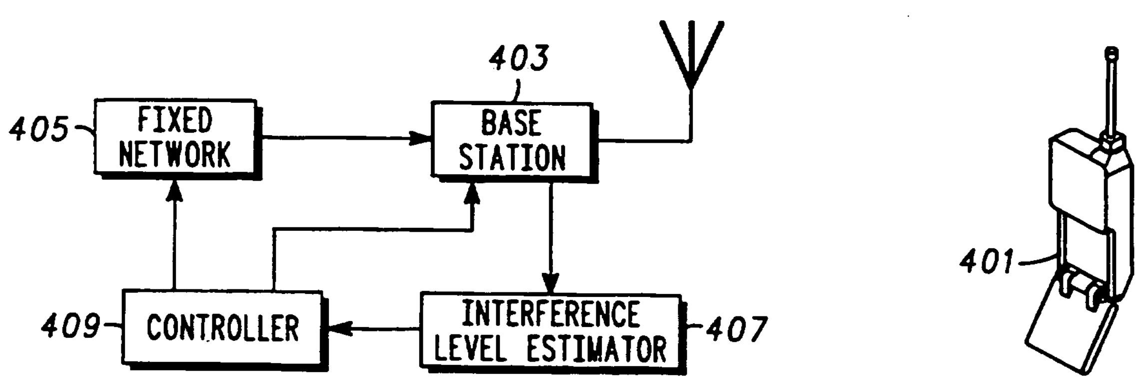


FIG. 4

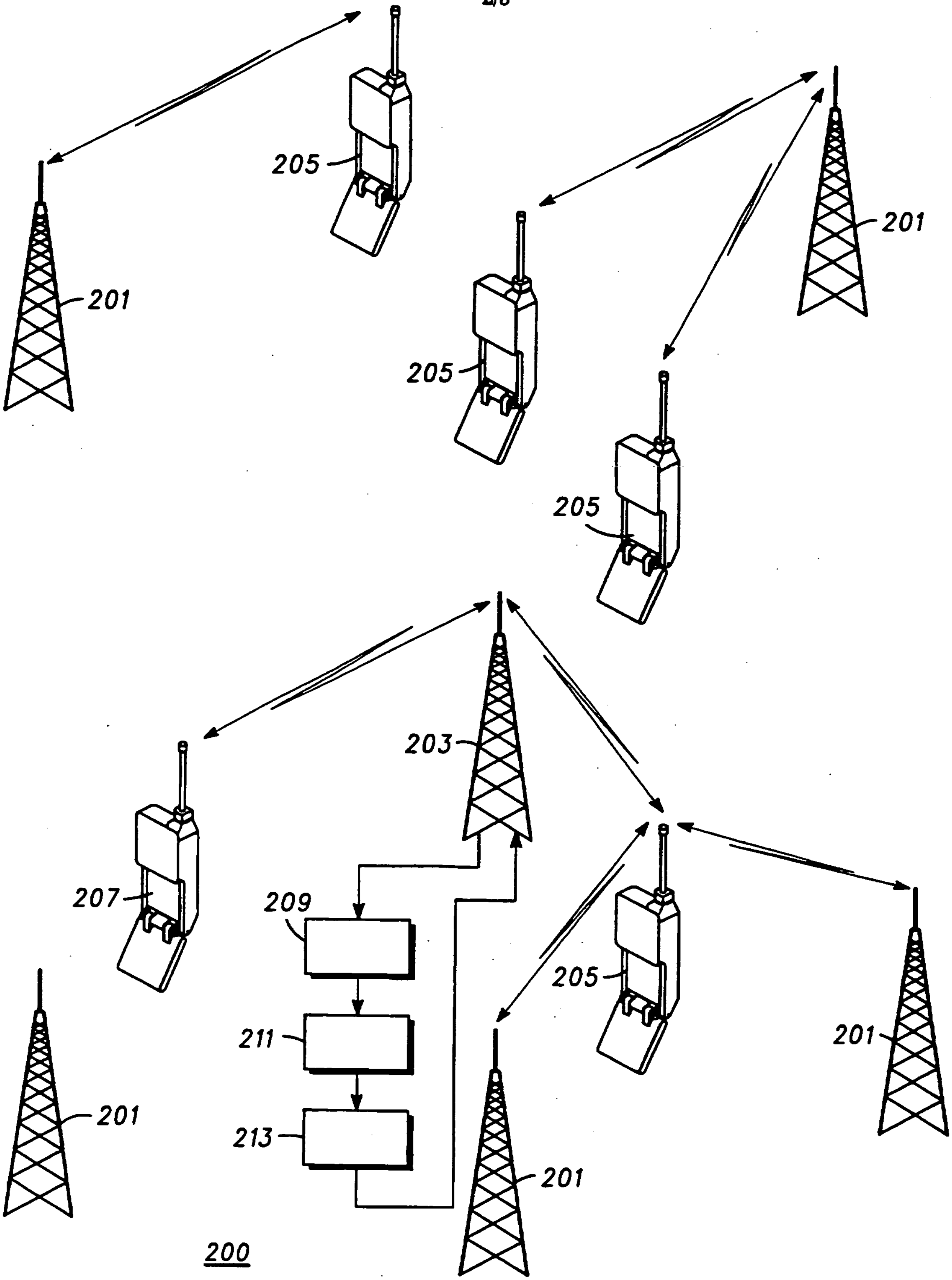


FIG. 2

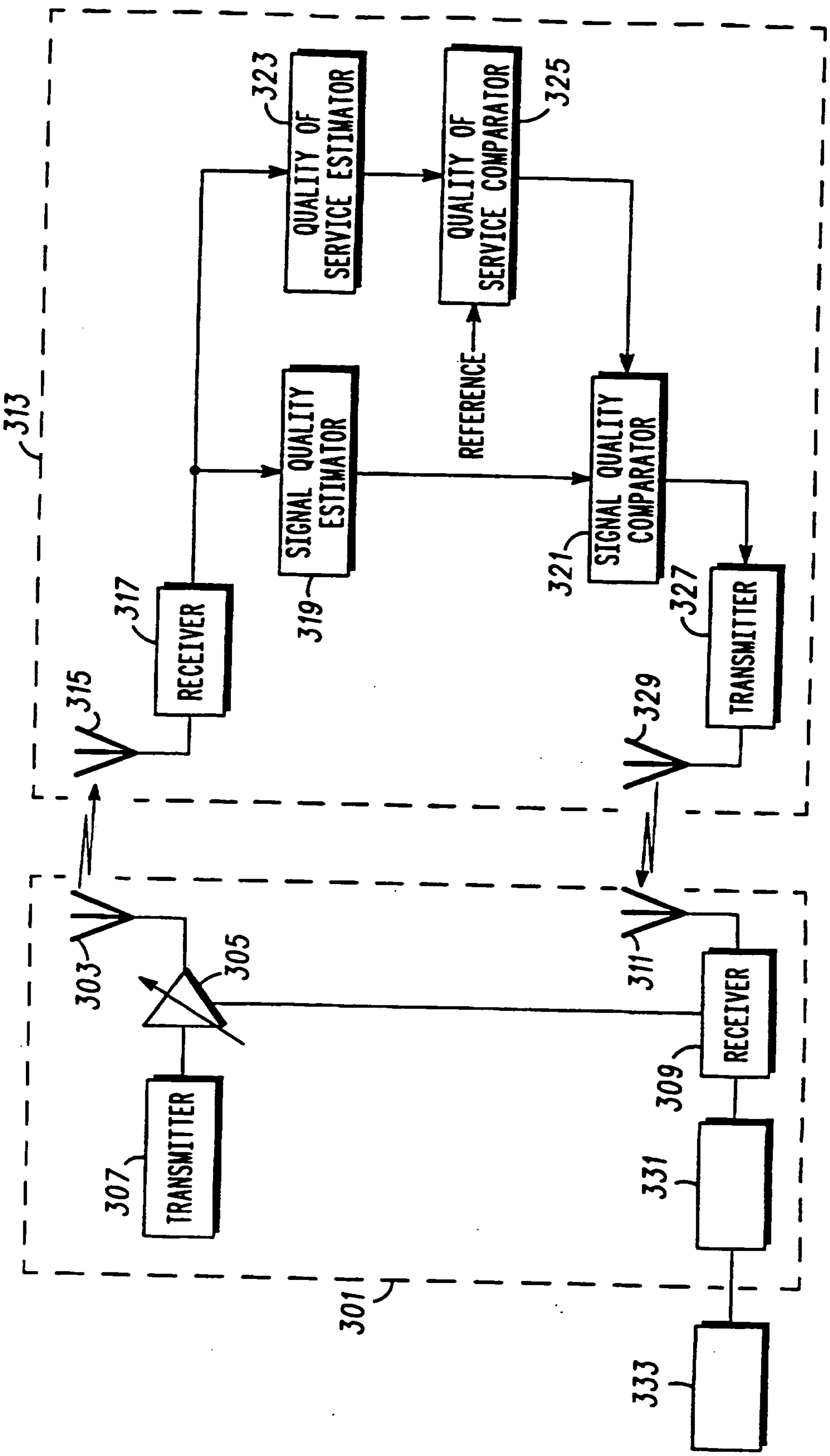

QUALITY OF SERVICE ESTIMATOR
323
QUALITY OF SERVICE COMPARATOR
325
REFERENCE
SIGNAL QUALITY ESTIMATOR
319
SIGNAL QUALITY COMPARATOR
321
313
RECEIVER
317
315
TRANSMITTER
327
329
303
305
TRANSMITTER
307
311
RECEIVER
309
331
301
333

FIG. 3

A COMMUNICATION SYSTEM AND METHOD THEREFOR

Field of the Invention

This invention relates to a communication system and particularly to a CDMA cellular radio communication system and a method therefor.

Background of the Invention

In a cellular communication system each of the subscriber units (typically mobile stations) communicates with typically a fixed base station. Communication from the subscriber unit to the base station is known as uplink and communication from the base station to the subscriber unit is known as downlink. The total coverage area of the system is divided into a number of separate cells, each predominantly covered by a single base station. The cells are typically geographically distinct with an overlapping coverage area with neighbouring cells. FIG. 1 illustrates a cellular communication system 100. In the system, a base station 101 communicates with a number of subscriber units 103 over radio channels 105. In the cellular system, the base station 101 covers users within a certain geographical area 107, whereas other geographical areas 109, 111 are covered by other base stations 113, 115.

As a subscriber unit moves from the coverage area of one cell to the coverage area of another cell, the communication link will change from being between the subscriber unit and the base station of the first cell, to being between the subscriber unit and the base station of the second cell. This is known as a handover. Specifically, some cells may lie completely within the coverage of other larger cells.

All base stations are interconnected by a fixed network. This fixed network comprises communication lines, switches, interfaces to other communication networks and various controllers required for operating the network. A call from a subscriber unit is routed through the fixed network to the destination specific for this call. If the call is between two subscriber units of the same communication system the call will be routed through

the fixed network to the base station of the cell in which the other subscriber unit currently is. A connection is thus established between the two serving cells through the fixed network. Alternatively, if the call is between a subscriber unit and a telephone connected to the Public Switched Telephone Network (PSTN) the call is routed from the serving base station to the interface between the cellular mobile communication system and the PSTN. It is then routed from the interface to the telephone by the PSTN.

A cellular mobile communication system is allocated a frequency spectrum for the radio communication between the subscriber units and the base stations. This spectrum must be shared between all subscriber units simultaneously using the system.

One method of sharing this spectrum is by a technique known as Code Division Multiple Access (CDMA). In a Direct Sequence CDMA (DS-CDMA) communication system, the signals are, prior to being transmitted, multiplied by a high rate code whereby the signal is spread over a larger frequency spectrum. A narrowband signal is thus spread and transmitted as a wideband signal. At the receiver the original narrowband signal is regenerated by multiplication of the received signal with the same code. A signal spread by use of a different code will at the receiver not be despread but will remain a wide band signal. In the receiver the majority of interference caused by interfering signals received in the same frequency spectrum as the wanted signal can thus be removed by filtering. Consequently a plurality of subscriber units can be accommodated in the same wideband spectrum by allocating different codes for different subscriber units. Codes are chosen to minimise the interference caused between subscriber units typically by choosing orthogonal codes when possible. A further description of CDMA communication systems can be found in 'Spread Spectrum CDMA Systems for Wireless Communications', Glisic & Vucetic, Artech house Publishers, 1997, ISBN 0-89006-858-5. Examples of CDMA cellular communication systems are IS 95 standardised in North America and the Universal Mobile Telecommunication System (UMTS) currently under standardisation in Europe.

The quality of the radio communication between the subscriber unit and the base station is determined by the signal to noise level of the signals where the noise includes both thermal noise and interference noise. Other base stations and subscriber units generate interference, which increases the noise level and thus reduces the quality. In order to attain an acceptable quality level the interference must thus be kept sufficiently low. A major technique for interference reduction in CDMA system is use of power control whereby the transmitted power of each subscriber unit and base station is maintained at the minimum level required for the signal to be received at an acceptable quality. Uplink power control can be implemented by the base station measuring the received signal quality and transmitting power up information to the subscriber unit when the signal quality is below an acceptable level, and power down information when the signal quality is above this level. Similarly, downlink power control can be implemented by the subscriber unit transmitting power up or power down information depending on the signal quality of the signal received at the subscriber unit.

As subscriber units share the same frequency spectrum in CDMA communication systems the radio communication between one subscriber unit and a base station will be interference to all other subscriber units using that frequency spectrum. As the number of subscriber units using the same spectrum increases the interference will increase until the radio communication of the individual subscriber unit cannot be reliably supported. The capacity of a CDMA communication system is thus heavily dependent on management of transmission power and interference levels.

Various methods are known for controlling resource allocation in cellular CDMA communication systems. However, a significant disadvantage of these is that they tend to be based on predetermined characteristics of supporting a given communication need. A communication need is typically a need for a specific service such as a high data rate connection, a voice call or a packet access point. However, only considering the communication need or provided service leads to inefficient usage of the available resource.

Summary of the Invention

The inventors of the current invention have realised that significant advantages can be achieved by considering the actual resource impact of supporting a given communication need rather than simply considering a predetermined impact typical for this communication need. These advantages include a more flexible resource usage and a more accurate cost evaluation of supporting a given communication need.

According to the present invention, there is provided a communication system having at least one base station serving at least a first subscriber unit, the first subscriber unit having a communication need; the communication system comprising: means for evaluating a relative resource impact dependent on a resource impact of supporting said communication need of said subscriber unit relative to a nominal resource impact of supporting said communication need; means for determining a cost function in response to said relative resource impact; and means for setting a characteristic of the communication system in response to said cost function.

According to a feature of the invention the relative resource impact is an interference increment caused by supporting the communication need. Alternatively, the relative resource impact can be dependent on the performance of the subscriber unit when supporting said communication need and/or a signal to noise level required for supporting said communication need. The nominal resource impact can for example be evaluated as the resource impact of supporting the specific communication averaged over all propagation conditions and assuming a subscriber unit having a specified performance. The characteristic of the communication system which is modified can for example be a resource allocation, call admission or a billing parameter such as the cost of the call.

Preferably the communication system is a CDMA cellular communication system.

According to a second aspect of the invention, there is provided a method of setting a characteristic of a communication system having at least one base station serving at least a first subscriber unit, the first subscriber unit having a communication need and the method comprising the steps of: evaluating a relative resource impact dependent on a resource impact of supporting said communication need of said subscriber unit relative to a nominal resource impact of supporting said communication need; determining a cost function in response to said relative resource impact; and setting a characteristic of the communication system in response to said cost function.

Typically, a given service will have an average resource impact, which in current communication systems is considered to only be dependent on the actual service. However, the inventors of the present invention have realised that the actual resource impact of supporting a given communication need varies significantly with the current characteristics of the communication systems. Accordingly, a cost function is derived in response to a relative resource impact and one or more characteristics of the communication system is set in response to this cost function. The cost function is typically not a monetary cost function although it may be related to a monetary cost. Rather the cost function is a general indication of the impact on the communication system of supporting the communication need of the subscriber unit.

According to an embodiment of the current invention the resource impact of supporting the communication need at this present time, with the current propagation environment and using the specific subscriber unit and base station is evaluated. This is then considered in relation to a nominal resource impact, which is typical for supporting this communication need. The nominal resource impact can be pre determined from information of an average resource impact for the given communication need. For example, it may be known that supporting a speech service of a well performing subscriber unit located midway between the base station and cell boundary under normal propagation conditions will cause a certain interference level at the base station. This

information can for example be obtained from dedicated measurements, simulations, calculations or from statistics gathered from the communication system during use.

When a specific subscriber unit accesses the communication system and requests a service the radio communication system will evaluate the resource impact in this specific case. This will include consideration of the actual propagation conditions, the actual location of the subscriber unit, the performance of the specific subscriber unit and other relevant parameters. The resource impact is then considered in relation to the nominal resource impact and the resulting relative resource impact is used in the derivation of a cost function.

The resulting cost function will be an indication of the resource cost of supporting the communication system. In accordance with the present invention this cost function includes consideration of the relative resource impact and is not simply related to a nominal resource impact of supporting the requested service. In one embodiment of the invention the cost function is used for determining whether the communication need is supported by the communication system. In this way, network capacity can be optimised by allocating resource depending on the actual resource impact of supporting the communication need. As a specific example the communication system can choose not to allocate resource to a subscriber unit which will have a relatively high resource impact for a given communication service. Instead it may choose to support two or more subscriber units which have exactly the same communication need but because of the specific conditions have a much lower resource impact.

In a different embodiment the cost function is used for deriving a monetary cost associated with supporting the call and hence used in determining how the user is charged for the current service.

The exact resource impact parameter determined will depend on the actual application. In CDMA communication systems for example, the interference caused by supporting other subscriber units is often the limiting factor for the capacity of the system.

Interference can thus be seen as a resource, which must be shared between users. Similarly, the signal to noise (including interference) ratio for one communication link can be increased by increasing the transmitted power. However, this increases the interference caused to other subscriber units thereby decreasing the signal to noise ratio for these subscriber units. The signal to noise ratio is thus also a resource which must be controlled between the users and thus is a suitable parameter for evaluating a resource impact. Other parameters include transmit power, spreading ratios of CDMA spreading codes,CDMA spreading codes, orthogonal variable spreading factor codes VSF and the number of soft-handover links. It will be apparent that many other parameters can be used for determining the resource impact in accordance with the present invention.

The invention thus allows the communication system to modify characteristics by considering the actual resource impact of supporting a given communication need. This results in for example the possibility of having a much more flexible and efficient resource allocation/

Brief Description of the Drawings

An embodiment of the present invention is described below, by way of example only, with reference to the Drawings, in which:

FIG. 1 is an illustration of a cellular communication system according to prior art;

FIG. 2 is an illustration of a CDMA communication system to which the invention is applicable;

FIG. 3 is an illustration of part of a communication system in accordance with an embodiment of the invention;

FIG. 4 is an illustration of part of a communication system in accordance with an embodiment of the invention.

Detailed Description of a Preferred Embodiment

The following description focuses on an embodiment in a CDMA cellular communication system compliant with the current approach for the standardisation of UMTS, but it will be apparent that the invention is not limited to this application.

FIG. 2 illustrates a UMTS communication system 200 to which the present invention is applicable. The communication system 200 comprises a large number of base stations 201, 203 serving a large number of subscriber units 205, 207. Typically, the base stations 201,203 will each cover a different geographical area although these areas typically will overlap. The base stations 201, 203 support a large number of subscriber units 205, 207 over radio channels 209, each subscriber unit 205,207 mainly being supported by the most appropriate base station 201,203 which is often the closest base station 201,203. When handing over from one cell to another, the subscriber unit 205, 207 can simultaneously be served by a plurality of base stations 203.

According to one embodiment of the invention, a subscriber unit 207 having a communication need transmits to an appropriate base station 203 and request a resource allocation. The communication system comprises means 209 for determining a relative resource impact of supporting the communication need of the subscriber unit 207. These means are in this embodiment connected to the base station 203 and bases the evaluation on information received from the base station 203.The relative resource impact depends on the communication need such as the communication service requested. However in accordance with the current invention, the current characteristics of the communication system and the specific characteristics of the subscriber unit and the base station involved in the call may be taken into account. The relative resource impact is calculated

by evaluating the resource impact of supporting the communication need of the subscriber unit and relating this to a nominal resource impact associated with supporting this communication need. The nominal resource impact can typically be an expected value of the resource impact obtained by previous calculations or simulations.

The means 209 for determining a relative resource impact are connected to means 211 for calculating a cost function based on the relative resource impact. The cost function represents an indication of the cost to the network of supporting the communication need and will typically take other parameters into consideration. However, typically the cost function will indicate an increased cost for increased relative resource impact. The means 209 for determining a relative resource impact are connected to means 213 for setting a characteristic of the communication system. These means 213 set one or more characteristics in response to the cost function. For example the resource allocation may be determined in response to the cost function. In the embodiment shown the means 213 for setting a characteristic of the communication system are operably coupled to the base station 203.

It will be apparent, that the means 209 for evaluating a relative resource impact, the means 211 for determining a cost function and the means 213 for setting a characteristic of the communication system can be located in the base station, the fixed network or be distributed in the communication system including the subscriber units themselves.

In operation the embodiment shown will thus first evaluate a relative resource impact by evaluating a relative resource impact dependent on a resource impact of supporting the communication need of the subscriber unit relative to a nominal resource impact of supporting said communication need. Subsequently, a cost function is determined in response to said relative resource impact; and finally a characteristic of the communication system is set in response to said cost function. This sequence can be repeated regularly, be carried out continually or can be carried out in response to other events such as an access request. Furthermore the order of the steps may be modified.

FIG. 3 illustrates an embodiment in accordance with the present invention wherein a signal to noise level has been used to determine the cost function. The figure illustrates a downlink embodiment but it will be apparent that the uplink embodiment is similar in principle although additional messages may be transmitted from the subscriber unit to the base station in this case.

A subscriber unit 301 comprises a transmit antenna 303, a variable power amplifier 305, a transmitter 307, a receiver 309 and a receive antenna 311. The transmit and receive antenna 303,311 are typically the same physical antenna but are for clarity here shown separately.

A base station 313 comprises a receive antenna 315, a receiver 317, a signal quality estimator 319, a signal quality comparator 321, a quality of service estimator 323, a quality of service comparator 325, a transmitter 327 and a transmit antenna 329.

The subscriber unit 307 has a communication need and the communication system hence supports this service. The transmitter 307 thus transmits the corresponding data and the signal is amplified by the variable amplifier 305 before being transmitted by the transmit antenna 303. The data is received by the receive antenna 315 and the data is recovered by the receiver 317. The signal quality estimator 319 estimates the signal quality based on the received signal. The quality of service estimator 323 evaluates the quality of the service provided. This is compared to a desired level of quality of service in the quality of service comparator 325. The output of the quality of service comparator 325 is a signal quality required to meet the desired quality of service. If the quality of service comparator 325 determines that the quality of service is lower than the desired level it will increase the signal quality requirement on the output of the comparator. If the quality of service is too high it will reduce the signal quality requirement. The signal quality comparator 321 compares the estimated signal quality from the signal quality estimator 319 with the signal quality requirement from the quality of service comparator 325. The result of the comparison is fed to the transmitter 321 and transmitted to the subscriber unit 301 via the transmit antenna 329. The subscriber unit receive antenna 311

receives the signal and the signal comparator output is recovered by the receiver 309. The receiver 309 comprises means for controlling the variable power amplifier 305 and will increase the transmitted power of the subscriber unit when the signal quality at the signal quality comparator is below the signal quality requirement. Conversely if the signal quality is too high, the transmit power will be reduced.

The embodiment of FIG. 3 is consistent with how power control is currently intended for UMTS. The signal quality loop is very fast and typically tracks variations in the propagation characteristics. The quality of service loop is slow and ensures that the average quality of service is sufficient. In UMTS the quality of service estimation will be determined on the basis of frame erasure rates whereas the signal quality estimation is based on signal level and bit error rates.

In the present embodiment the signal quality requirement is transmitted to the base station 301 and used for determining a cost function. The base station 301 thus includes means 331 for determining a cost function in response to the signal quality. A subscriber unit having a specific service supported will typically reach a reasonably static condition where the variations in the signal quality requirement are relatively low. The signal quality requirement in this case is thus an indication of how much resource on average is required for supporting the communication need of the subscriber unit. The value will vary between different subscriber units even for identical services. Variations will be due to e.g. the performance of the mobile, the current propagation characteristics, the location of the mobile etc. The signal quality requirement thus directly reflects the system resource cost of supporting the given service for the given subscriber unit under the given conditions. The means 331 for determining a cost function will thus comprise means for comparing the signal quality requirement of the current link with a nominal expected signal quality requirement for the service provided. The result is used for determining the cost function which may also include other considerations.

A billing structure for a communication system will typically have a cost related to a specific service. As described above the actual resource used by a given service depend

on the current conditions and can vary significantly for the same service. According to the current embodiment the invention comprise means 333 for changing a characteristic of the communication system. In this case the characteristic of the cost associated with a specific service is modified according the signal quality requirement resulting from supporting this service and the consequent interference to other users within the network. The communication system will thus have a pre-determined billing structure based on the service and resource (signal and interference) provided. However, in addition a nominal signal quality value for this service is prescribed and if a specific call results in a signal quality requirement higher than this value the cost is increased whereas it is decreased for lower signal quality requirements. Alternatively, a simple billing structure relating signal quality requirement to actual cost can be employed. When determining this billing structure estimations of nominal performances will inherently be used and thus embedded in the billing database. It is thus apparent that a direct comparison to a nominal value is not required but may be very indirect such as simply be the reference used when determining a relation between a resource impact and a cost function.

FIG. 4 illustrates a different embodiment in accordance with the present invention. A subscriber unit 401 is supported by a base station 403, which is connected to the fixed network 405. An interference level detector 407 is connected to the base station and the output of the interference level detector is connected to a controller 409. The controller is operable to control elements of the base station 403 and the fixed network 405.

According to this embodiment the interference level received at the base station is estimated by the interference level estimator prior to supporting a communication from the subscriber unit 401. If the subscriber unit requests a service this request is met by the base station and communication commences. This results in an increased interference level at the base station due to the extra interference caused by the subscriber unit 401. The interference level estimator estimates the interference level after communication with the subscriber unit 401 has begun and determines the increase in interference level by subtracting the value from before this communication was commenced. The interference increment relates to the actual resource impact of supporting the

communication need of the subscriber unit and is thus communicated to the controller, which calculates a cost function in response to this value. The controller is operable to control the call admission i.e. it is operable to terminate the service of the subscriber unit 401 if the interference increment is too high or to flexible allocate resource depending on the interference increment. For example, if the interference increment is very high only a resource for a less demanding data service which only partially meets the communication need of the subscriber unit is allocated. Alternatively the controller is operable to modify the billing of the user according to the interference increment.

It will be apparent that the same principle as described above for the downlink can be applied to the uplink. In this case, supporting a new subscriber unit will increase the downlink interference to other subscriber units. These will respond by requesting increased transmit power from the base station through the power control commands. The increment in transmitted power by the base station can thus be used as an indicator of the interference increment. Alternatively, the subscriber units can include means for measuring interference and the measurements can be transmitted back to the base stations and fixed network.

According to a different embodiment the nominal resource impact is continually evaluated by measuring the performance of a subscriber unit using the same service. A statistical evaluation of the resource impact for supporting this service can be built up and used for comparing the resource impact of the current communication need. For example, a 64kbps service with a given bit error rate and delay may over time be requested by many subscriber units. The fixed network may obtain information of the required signal quality for supporting this service. Over time and average signal quality is thus determined and the variance of this can be determined. When a subscriber unit consequently uses the 64kbps service the current required signal quality will be compared to the distribution gathered and the cost function can be changed in accordance with how much the current signal quality requirement differs from the average. When building up information of the required signal quality other related services may provide information which can be included. For example, a different

64kbps service with the same bit error rate but a longer delay may be sufficiently related to provide useful statistical information related to the original 64kbps.

An important advantage of the described embodiments is that they inherently take the performance of the subscriber units into account when determining the cost function. In for example UMTS, subscriber units from different manufactures will have varying performance characteristics for the same conditions. Specifically, different manufacturers will choose to have different RAKE finger management algorithms and numbers of allocated RAKE fingers. A RAKE finger is the term used for a CDMA receiver functional entity responsible for receiving an individual signal component. The more RAKE fingers the better is the potential performance and the higher the complexity and thus cost of the subscriber unit. By reducing the number of RAKE fingers the manufacturer can thus reduce the cost of the subscriber unit while trading off performance of the network but not the specific subscriber unit in question. However, the power control algorithms will always ensure that the signals are received at an acceptable level and quality. There is thus no incentive for a manufacturer to produce high performing subscriber units as it will not affect the perceived performance of the subscriber unit. However, the performance of the network as a whole will be affected and a significant loss in capacity can result. The embodiments described above have the inherent benefit that the cost depends on the performance of the subscriber unit and badly performing subscriber unit will thus be penalised.

It will be apparent that the calculation of the cost function can be done at call set-up, i.e. when a new service is requested. However, it will be apparent that the cost function and system modification can be carried out at any time and as frequently as desired. The cost function may thus be calculated on a regular or even continuous basis and the communication system may continually be updated in response to the calculated cost function.

The cost function can also consider many other aspects than the relative resource impact of supporting the communication need of the subscriber unit. These parameters included but are not limited to the following:

a) The speed of the subscriber unit.

As an example, the speed at which the subscriber unit is travelling will determine how fast the current propagation conditions change. The cost function can thus include this consideration so that an instantaneous high relative resource impact is not weighted heavily when the subscriber unit is fast moving as this resource impact is likely to change quickly. However, for a static subscriber unit the resource impact is more unlikely to change in the short term and the relative resource impact may be weighted higher in the calculation of the cost function.

b) The communication need.

The cost function is likely to include not only the relative resource impact but also the communication need and thus the service provided in itself. Depending on the communication need and the service, the computational requirements, the time of the service and many other system parameters may impact the cost of the system of providing this service. The cost function can also simply include the perceived value of the service or communication need regardless of whether this will require additional resource to meet.

c) The location of the subscriber unit.

The cost function can also consider the location of the subscriber unit. As an example, if the subscriber unit is close to the base station it will be easier to support the communication need and the cost function can reflect this. Alternatively, propagation characteristics may be known for different areas and when calculating the cost function knowledge of propagation conditions can be considered based on knowledge of which area the subscriber unit is located in. Alternatively, location of the subscriber unit can be included for purely commercial reasons where for example there is a commercial reason for supporting communication needs in a specific area.

d) The base station transmit power level.

As described above the base station transmit power level can be an indication of the level of downlink interference and thus of how heavily the system is loaded. This can be included in the cost function so that a given resource impact is considered of significantly higher cost to the system when this is heavy loaded than when it is only lightly loaded.

It will be apparent that the invention is not limited to controlling resource allocation, call admission or billing as previously described. Many other characteristics of the communication system can be modified based on the cost function. These include:

1. A serving base station.

Dependent on the cost function the system may allocate a serving base station. For example, if two suitable serving base stations are identified the system may allocate the one having more spare capacity when the resource impact is very high whereas it may allocate the one having the best link performance when the resource impact is very low.

2. A service.

The communication system may provide a specific service in dependence of the cost function. For example, when the resource impact is very high and the system is very heavily loaded the cost function can indicate a high cost. The communication system can in this case decide that this cost is too high and that the communication need cannot be met fully. Instead it may provide a different service, such as a lower data rate than requested, thereby partially meeting the communication need of the subscriber unit.

3. Handover parameters.

The handover parameters used for determining handovers can be modified in response to the cost function. For example, the handover parameters may be modified in favour of handing over from a heavily loaded cell to a lightly loaded cell when the cost impact is

very high whereas there are modified in favour of the best serving base station when the cost function indicates low cost impact.

Claims

1. A communication system having at least one base station serving at least a first subscriber unit, the first subscriber unit having a communication need; the communication system comprising:

means for evaluating a relative resource impact dependent on a resource impact of supporting said communication need of said subscriber unit relative to a nominal resource impact of supporting said communication need;

means for determining a cost function in response to said relative resource impact; and

means for setting a characteristic of the communication system in response to said cost function.

2. A communication system as claimed in claim 1 wherein the relative resource impact is evaluated for an interference resource.

3 A communication system as claimed in claim 1 wherein the relative resource impact is evaluated as an interference increment caused by supporting the communication need.

4. A communication system as claimed in claim 1 wherein said relative resource impact is dependent on the performance of the subscriber unit when supporting said communication need.

5 A communication system as claimed in claim 1 wherein the relative resource impact is evaluated in response to a signal to noise level required for supporting said communication need.

6. A communication system as claimed in claim 1 wherein said nominal resource impact is determined in response to the resource impact of other subscriber units supporting similar communication needs.

7. A communication system as claimed in claim 1 wherein the relative resource impact is evaluated in response to propagation conditions between the subscriber unit and the at least one base station.

8. A communication system as claimed in any preceding claim wherein said cost function is also determined in response to a parameter chosen from the group of:

a) the speed of the subscriber unit;
b) the communication need;
c) the location of the subscriber unit; and
d) the base station transmit power level,

9. A communication system as claimed in any preceding claim wherein the characteristic of the communication system is chosen from the group of

a) a cost for supporting the communication need;
b) a resource allocation;
c) a call admission;
d) a serving base station;
e) a service; and
f) handover parameters.

10. A communication system as claimed in any preceding claim wherein the cost function is evaluated at call set-up.

11. A communication system as claimed in any preceding claim wherein the communication system is a cellular radio communication system.

12. A communication system as claimed in claim 11 wherein the communication system is a CDMA cellular communication system.

13. A method of setting a characteristic of a communication system having at least one base station serving at least a first subscriber unit, the first subscriber unit having a communication need and the method comprising the steps of:

evaluating a relative resource impact dependent on a resource impact of supporting said communication need of said subscriber unit relative to a nominal resource impact of supporting said communication need;

determining a cost function in response to said relative resource impact; and

setting a characteristic of the communication system in response to said cost function.

14. A communication system substantially as hereinabove described with reference to or as shown in the Figures 2 to 4.

15. A method of setting a characteristic of a communication system substantially as hereinabove described with reference to or as shown in the Figures 2 to 4.

Application No:	GB 9904242.6	**Examiner:**	Catherine Schofield
Claims searched:	1-15	**Date of search:**	30 June 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): H4L (LDTT, LFM)

Int Cl (Ed.6): H04M: 15/00; H04Q: 3/00, 7/22

Other: Online:- WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	WO 98/52288 A1 (MOTOROLA) - see particularly p.6, line 30 to p.9, line 18	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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